

CLAIMS

1. A method of manufacturing a semiconductor device comprising:
a preparation process step of supplying a substance for restricting
formation of nuclei for growing a metal film or a metal compound film onto a
5 surface of a process target substrate; and
a film forming step of forming a metal film or a metal compound film
whose surface has bumps on said substrate by supplying a material of said metal
film or said metal compound film onto the surface of said substrate after said
preparation process step.
- 10 2. The method of manufacturing a semiconductor device according
to claim 1, wherein:
said preparation process step comprises a step of supplying a substance for
restricting adhesion of NH_3 onto the surface of said substrate; and
said film forming step comprises a step of forming a tungsten nitride film
15 whose surface has bumps on said substrate by supplying WF_6 and NH_3 onto the
surface of said substrate.
3. The method of manufacturing a semiconductor device according
to claim 2, wherein
said preparation process step comprises a step of restricting adhesion of
20 NH_3 onto the surface of said substrate by supplying a halogen element onto the
surface of said substrate.
4. The method of manufacturing a semiconductor device according
to claim 3, wherein
said preparation process step comprises a step of supplying ClF_3 or WF_6
25 onto the surface of said substrate as said halogen element.
5. The method of manufacturing a semiconductor device according
to claim 2, wherein
said preparation process step comprises a step of restricting adhesion of
 NH_3 onto the surface of said substrate by bonding groups made of C and H onto the
30 surface of said substrate.

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6. The method of manufacturing a semiconductor device according to claim 5, wherein

said preparation process step comprises a step of coating at least one of HMDS ($((\text{CH}_3)_3\text{SiNHSi}(\text{CH}_3)_3)$), alcohol, and ketone onto the surface of said substrate in order to bond groups made of C and H onto the surface of said substrate.

7. The method of manufacturing a semiconductor device according to claim 5, wherein

said preparation process step comprises a step of exposing the surface of said substrate to vapor of at least one of HMDS, alcohol, and ketone in order to bond groups made of C and H onto the surface of said substrate.

8. The method of manufacturing a semiconductor device according to claim 6, wherein

said preparation process step comprises a step of using $\text{C}_2\text{H}_5\text{OH}$ as the alcohol.

9. The method of manufacturing a semiconductor device according to claim 7, wherein

said preparation process step comprises a step of using $\text{C}_2\text{H}_5\text{OH}$ as the alcohol.

10. The method of manufacturing a semiconductor device according to claim 6, wherein

said preparation process step comprises a step of using CH_3COCH_3 as the ketone.

11. The method of manufacturing a semiconductor device according to claim 7, wherein

said preparation process step comprises a step of using CH_3COCH_3 as the ketone.

12. A method of manufacturing a semiconductor device comprising:
a preparation process step of supplying a halogen element onto a surface of a substrate; and

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a film forming step of forming a metal film or a metal compound film whose surface has bumps on said substrate by supplying a material of said metal film or said metal compound film onto the surface of said substrate after said preparation process step.

- 5 13. A method of manufacturing a semiconductor device comprising:
a preparation process step of bonding groups made of C and H onto a surface of a substrate; and

a film forming step of forming a metal film or a metal compound film whose surface has bumps on said substrate by supplying a material of said metal
10 film or said metal compound film onto the surface of said substrate after said preparation process step.

14. The method of manufacturing a semiconductor device according to claim 1, wherein

said film forming step controls a shape of the bumps on said metal film or
15 said metal compound film formed in said film forming step by controlling a time in which a preparation process is performed.

15. The method of manufacturing a semiconductor device according to claim 12, wherein

said film forming step controls a shape of the bumps on said metal film or
20 said metal compound film formed in said film forming step by controlling a time in which a preparation process is performed.

16. The method of manufacturing a semiconductor device according to claim 13, wherein

said film forming step controls a shape of the bumps on said metal film or
25 said metal compound film formed in said film forming step by controlling a time in which a preparation process is performed.

17. An apparatus for manufacturing a semiconductor device comprising:

a first process room in which a preparation process is applied to a
30 substrate;

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a restriction substance supply source which supplies a restriction substance for restricting formation of nuclei for growing a metal film or a metal compound film to said first process room;

a second process room in which a film forming process for forming a
5 metal film or a metal compound film whose surface has bumps is performed; and

a material gas supply source which supplies a material gas for forming said metal film or said metal compound film whose surface has bumps to said second process room.

18. The apparatus for manufacturing a semiconductor device
10 according to claim 17, wherein:

said restriction substance supply source supplies onto a surface of said substrate which is arranged on a predetermined position in said first process room, a gas including a halogen element for restricting adhesion of NH_3 as the preparation process; and

15 said material gas supply source forms a tungsten nitride film on said substrate by supplying WF_6 gas and NH_3 gas onto the surface of said substrate to which the preparation process has been applied.

19. The apparatus for manufacturing a semiconductor device
according to claim 18, wherein
20 said restriction substance supply source supplies WF_6 or ClF_3 as the halogen element.

20. The apparatus for manufacturing a semiconductor device
according to claim 18, wherein
said restriction substance supply source includes gas guiding means for
25 supplying the gas including a halogen element onto said substrate substantially uniformly.

21. The apparatus for manufacturing a semiconductor device
according to claim 17, wherein
said first process room and said second process room are capable of
30 keeping a pressure therein at a predetermined level, and are connected to each other

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via a vacuum room which includes transportation means for transporting said substrate.

22. The apparatus for manufacturing a semiconductor device according to claim 17, wherein

5 said first process room and said second process room are a same process room.

23. The apparatus for manufacturing a semiconductor device according to claim 18, wherein

10 said material gas supply source supplies WF_6 gas and NH_3 gas onto said substrate in said second process room via different paths respectively.

24. The apparatus for manufacturing a semiconductor device according to claim 17, wherein:

15 said restriction substance supply source supplies a substance including groups made of C and H as the restriction substance as the preparation process; and said first process room includes coat and dry means for bonding groups made of C and H onto a surface of said substrate by coating and drying the restriction substance on the surface of said substrate.

25. The apparatus for manufacturing a semiconductor device according to claim 17, wherein:

20 said restriction substance supply source supplies a substance including groups made of C and H as the restriction substance as the preparation process; and said first process room includes means for bonding groups made of C and H onto a surface of said substrate by flowing vapor of the restriction substance above the surface of said substrate.

25 26. The method of manufacturing a semiconductor device according to claim 1, wherein:

said preparation process step is a step of supplying the substance for restricting formation of nuclei onto the surface of said substrate that is substantially plane; and

30 said film forming step is a step of forming a metal film or a metal

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compound film which has bumps on said substrate.

27. The method of manufacturing a semiconductor device according to claim 1, wherein:

said preparation process step is a step of supplying the substance for
5 restricting formation of nuclei onto the surface of said substrate that has predetermined roughness; and

said film forming step is a step of forming on said substrate, a metal film or a metal compound film which has bumps that are rougher than the surface of said substrate.

10 28. The method of manufacturing a semiconductor device according to claim 1, further comprising

a step of forming a conductive film which faces said metal film or said metal compound film via an insulation material,
wherein said method forms capacitance.

15 29. The method of manufacturing a semiconductor device according to claim 12, wherein:

said preparation process step is a step of supplying the substance for restricting formation of nuclei onto the surface of said substrate that is substantially plane; and

20 said film forming step is a step of forming a metal film or a metal compound film which has bumps on said substrate.

30. The method of manufacturing a semiconductor device according to claim 12, wherein:

said preparation process step is a step of supplying the substance for
25 restricting formation of nuclei onto the surface of said substrate that has predetermined roughness; and

said film forming step is a step of forming on said substrate, a metal film or a metal compound film which has bumps that are rougher than the surface of said substrate.

30 31. The method of manufacturing a semiconductor device according

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to claim 12, further comprising

a step of forming a conductive film which faces said metal film or said metal compound film via an insulation material,

wherein said method forms capacitance.

5 32. The method of manufacturing a semiconductor device according to claim 13, wherein:

said preparation process step is a step of supplying the substance for restricting formation of nuclei onto the surface of said substrate that is substantially plane; and

10 said film forming step is a step of forming a metal film or a metal compound film which has bumps on said substrate.

33. The method of manufacturing a semiconductor device according to claim 13, wherein:

15 said preparation process step is a step of supplying the substance for restricting formation of nuclei onto the surface of said substrate that has predetermined roughness; and

said film forming step is a step of forming on said substrate, a metal film or a metal compound film which has bumps that are rougher than the surface of said substrate.

20 34. The method of manufacturing a semiconductor device according to claim 13, further comprising

a step of forming a conductive film which faces said metal film or said metal compound film via an insulation material,

wherein said method forms capacitance.

25 35. The apparatus for manufacturing a semiconductor device according to claim 17, wherein

said second process room forms a metal film or a metal compound film on a surface of said substrate on which formation of nuclei is restricted by the process performed in said first process room, the surface having predetermined roughness
30 and said metal film or said metal compound film having bumps which are rougher

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than the surface of said substrate.

36. The apparatus for manufacturing a semiconductor device according to claim 17, wherein

said second process room forms a metal film or a metal compound film
5 which has bumps on a surface of said substrate on which formation of nuclei is restricted by the process performed in said first process room, the surface being plane.

37. The apparatus for manufacturing a semiconductor device according to claim 17, further comprising:

10 a device which forms an insulation material on said metal film or said metal compound film; and

a device which forms a conductive material on said insulation material.

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